1987 Rivers Inlet Echo Sounding Program Summary Report

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ABSTRACT

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Sockeye salmon escapement past the Rivers Inlet (Department of Fisheries and Oceans, Statistical Area 9) commercial fishery is monitored by an echo sounding program conducted at the head of the inlet. This report summarizes the field data collected during the 1987 Rivers Inlet echo sounding program.

RESUME

Thomson, B.L. 1988. 1987 Rivers Inlet echo sounding program: summary report. Can. Data Rep. Fish. Aquat. Sci. 713. iii + 22 p. + Appendix

La peche commerciale du saumon sockeye qui remonte le bras de mer Rivers (ministere des Peches et des Oceans, secteur statistique no 9) est controlee au moyen d'un systeme d'echo-sondage mis en place a l'extremite du bras de mer. Ce rapport recapitule les donnees fournies par le programme d'echo-sondage du bras de mer Rivers durant 1987.

INTRODUCTION

The Rivers Inlet (Canadian Department of Fisheries and Oceans, Statistical Area 9) sockeye salmon escapement past the commercial salmon fishery is monitored by an in-season echo sounding program (Figure 1). The program provides a daily estimate of sockeye abundance at the head of the inlet. Soundings are conducted nightly along a series of transects that traverse the head of the inlet (Figure 2). The information from the program is used in conjunction with weekly catch and effort levels to manage the sockeye fishery in Area 9.

METHODS

ECHO SOUNDING THEORY

Echo sounders have been used since the mid-1930's in fisheries research. Initially, they were used to detect fish presence. Latterly, echo sounders have been used to study distribution, abundance and behaviour (Forbes and Nakken 1972). Echo sounding can be used to estimate relative or absolute fish abundance (Thorne 1983). Analyses may be made of multiple-echo traces measuring fish density, or single-echo traces representing individual targets. Many fish species that form schools in daylight hours disperse in darkness allowing single-echo counts to be made (Sameoto *et al.*). Rivers Inlet sockeye salmon appear to disperse and migrate into the upper water layers in the absence of light (Wood and Mason 1971).

An echo sounder is a vertically oriented sonar system commonly located beneath the vessel keel. The sounder consists of four parts: a transmitter, transducer, receiver-amplifier and the control and display system. The transmitter emits a pulse of electrical energy which is transformed by the transducer into an acoustical signal. The signal bounces off of targets or the sea bottom, reflecting back to the transducer. The signal is reconverted into electrical energy, then amplified by the receiver-amplifier and modified for display. Display can be either with a chart-recorder or an oscilloscope (Forbes and Nakken 1972).

The width of the acoustic beam, representative of the sampled area, is dependent upon the size of the transducer in relation to the signal frequency. A time-varied gain (TVG) is incorporated into the sounder, compensating for losses due to spreading and attenuation in the returning echo (Forbes and Nakken 1972). Multiple-echo traces are recorded at a TVG setting of 20 Log R (where R = the range to the fish) and single-echo traces at TVG = 40 Log R (Simrad EY-M Manual).

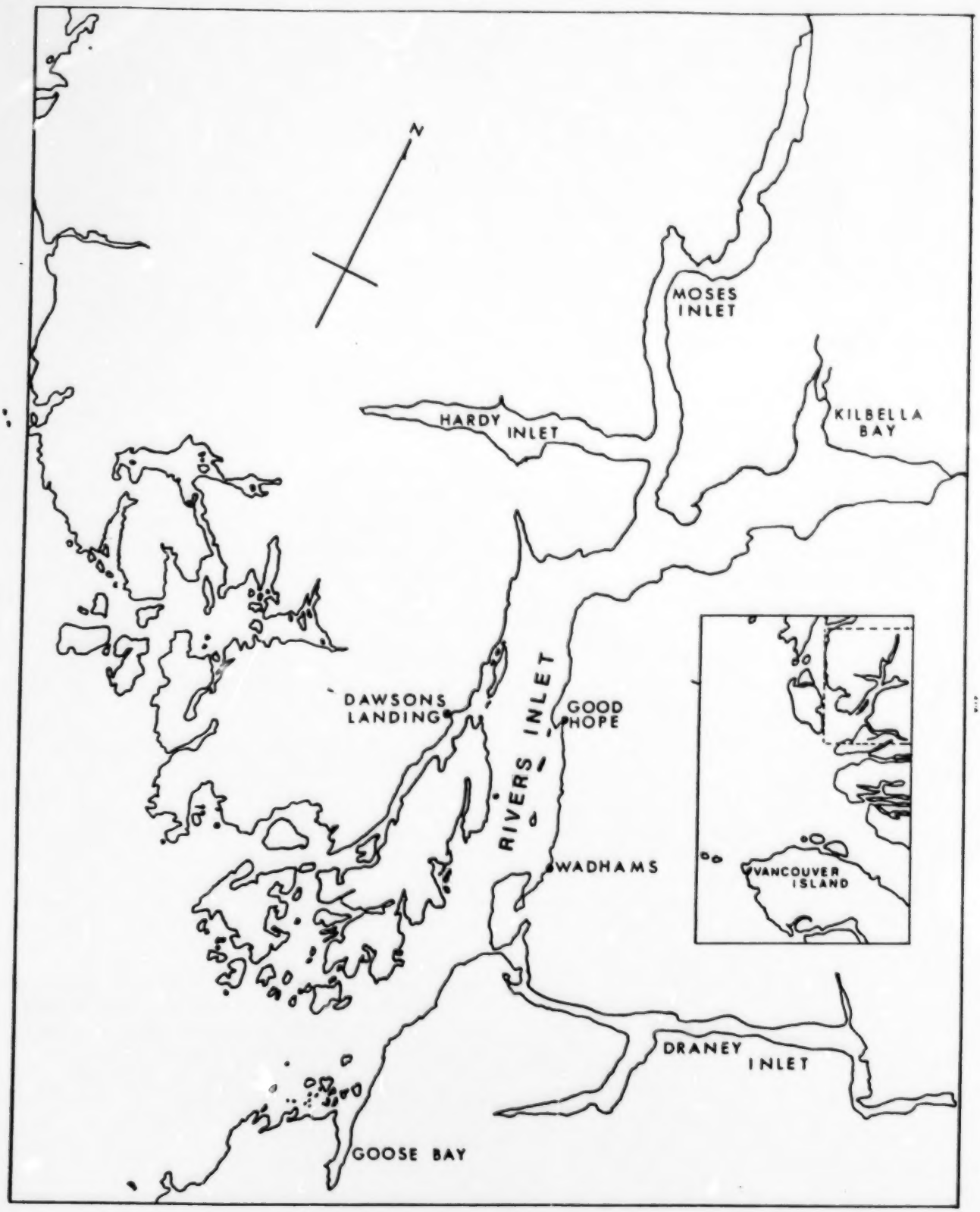

FIGURE 1. Rivers Inlet (Statistical Area 9), B.C.

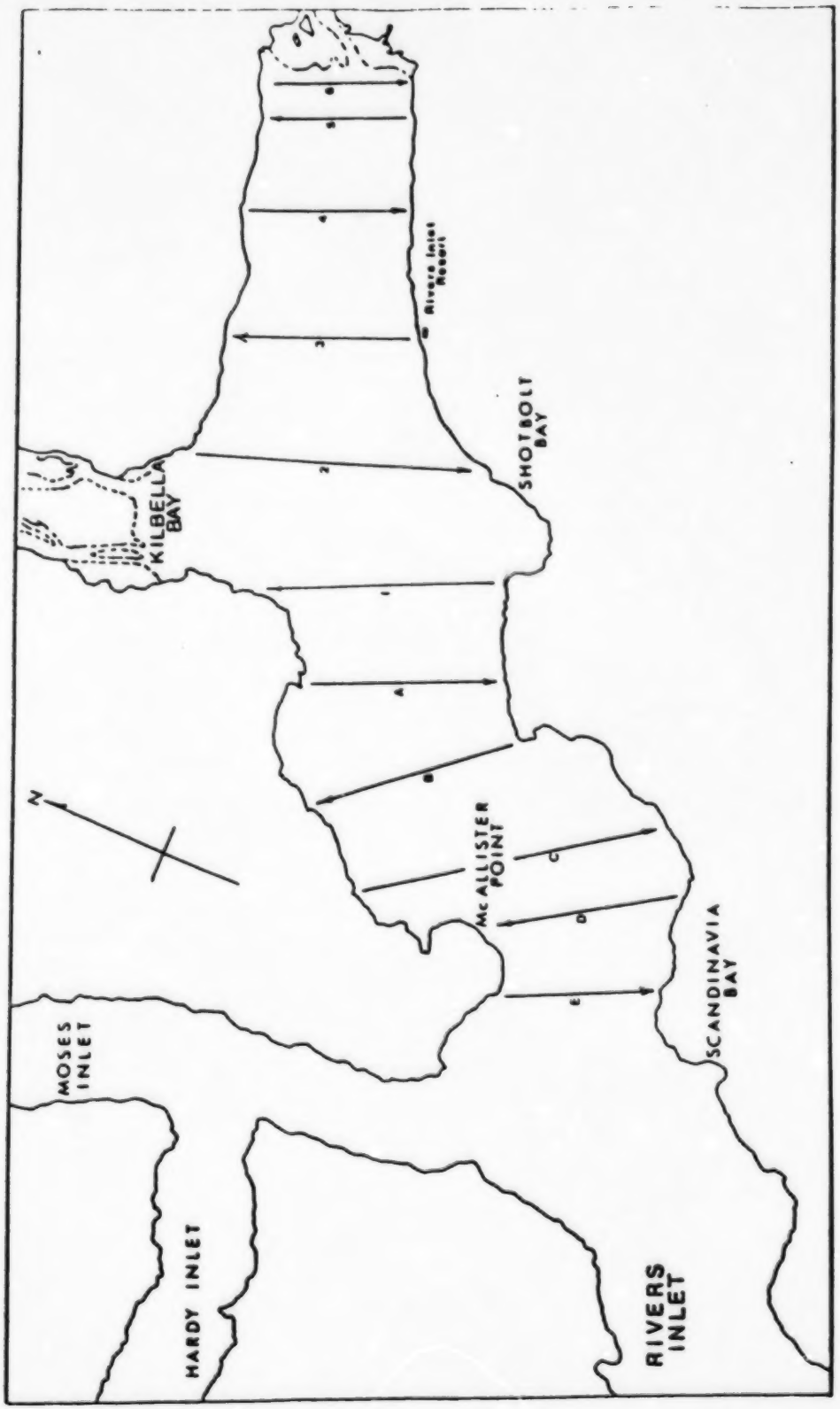

FIGURE 2. Miss Robyn Grid and R.D. 102 Grid, Rivers Inlet.

There are two types of paper chart recorders used in conjunction with echo sounding. The wet paper recorders are generally more sensitive than the dry. However, their use is limited for permanent records as the recordings fade quickly and the papers require careful storage both before and after use. The dry paper recorders have an electrically reversing surface. The paper passes over a metal plate. Echoes are burnt onto the recording paper as electrical pulses are transmitted between the wire stylus and plate.

The target or signal strength of the object being sounded determines the relative size and density of the echo recorded. In general, the target strength of a fish increases with the cube of its length. The swimbladder, if present, accounts for approximately one-half of the signal. The signal strength is also affected by the position and orientation of the fish in the sounding beam.

The estimation of fish abundance from echo counting is based on the following assumptions (Kieser and Mulligan 1984):

1) the recorded distribution of fish along the insonified transect is representative of the distribution of fish in the area represented by the transect.
2) the fish do not avoid the survey vessel.
3) the echoes do not overlap.
4) the insonified fish are of a uniform size and have a single representative target strength (TS).
5) the echoes from smaller fish are below a threshold level and are not recorded at the chosen gain (TVG).

Thorne (1983) summarizes the advantages and disadvantages of echo sounding techniques used in fisheries management.

Advantages:

1) an independence from fishery catch statistics. Population sizes can be surveyed prior, during or after the fishery with no impact on the population size itself.
2) there is no time lag associated with the sampling, and low operating costs allow more frequent sampling.
3) there may be a lower variance associated with the estimate of stock size because more samples can be taken for the equivalent cost in time and money as in other sampling procedures.
4) though the method is usually used only as an index of abundance, it does have the potential for absolute population estimation.

Disadvantages:

1) poor species discrimination between targets. This drawback is usually countered by performing complementary net sampling to identify species composition in the sounding area.
2) relatively little or no sampling capability near the surface or bottom. The transducer beam forms 1-2 fathoms below the water surface preventing sampling of targets in the upper water layers. However, there is usually some degree of boat avoidance by fish in these layers, minimizing the numbers missed by the transducer. In addition, fish may remain beneath the surface freshwater-seawater interface zone in coastal areas. Sampling problems at the seabed level are due to characteristics of the beam and the pulse length.
3) relatively high complexity involved with the mathematical, physical and electrical principles.
4) high initial investment.
5) no collection of biological samples through the actual echo sounding. Limited samples may be available through the associated net sampling.
6) potential bias associated with uncertainty over fish target strength and equipment calibration.

For more extensive coverage of these points consult Thorne (1983).

1987 Rivers Inlet Echo Sounding Program

The 1987 Rivers Inlet echo sounding program ran for 19 nights, from July 8-July 26. A trial run was performed the evening of July 7 to test the equipment and to demonstrate the procedures to follow.

The indications of sockeye abundance in the sanctuary area were poor for the first few nights of the survey. It was decided that it was more important to establish a presence of fish moving into the sanctuary area than to estimate actual numbers during this time. Thus, for the nights of July 9 and July 10, the grid patterns followed in the Miss Robyn grid were incomplete and additional soundings were performed in the non-grid sub-areas 9-4, and 9-5.

The sockeye run to Rivers Inlet was approximately 1-2 weeks later than originally anticipated. This run timing was consistent with sockeye returns experienced in other regions of the coast. The later return was reflected in both the sounding results and the commercial catch figures for Area 9 (Tables 1 & 2). The main part of the sockeye run appears to have come in a more compressed time period this year in comparison to previous years.

TABLE 1. 1987 DAILY SOCKEYE ESTIMATES FROM ECHO SOUNDINGS.

DATE	MISS ROBYN GRID 6	5	4	3	2	1	TOTAL MISS ROBYN	RD 102 GRID A	B	C	D	E	TOTAL RD 102 GRID	TOTAL ALL GRIDS
JULY 7/8	*	*	*	*	*	*	*							
JULY 8/9	0	0	0	0	1149	1165	2314	0	0	0	0	0	0	0*
JULY 9/10	0	0	0	*	*	0	*	0	1086	0	0	0	1086	3400
JULY 10/11	238	740	*	*	*	0	978*	899	0	0	0	0	899	899*
JULY 11/12	0	0	1189	0	0	1398	2587	0	0	542	518	0	1060	2038*
JULY 12/13	0	0	0	0	0	2331	2331	0	1223	1222	1532	0	3977	6564
JULY 13/14	328	139	2010	7836	4567	3205	18085	8087	5432	2158	2313	554	18544	20875
JULY 14/15	332	139	1209	9293	19921	16610	47504	4025	3397	8295	3940	4351	24008	42093
JULY 15/16	476	0	381	6589	21943	2739	32128	13167	2581	3724	3919	1251	24642	72146
JULY 16/17	245	1896	536	1829	0	5332	9838	3821	10407	19975	11280	2900	48383	80511
JULY 17/18	0	139	1452	0	0	1574	3165	1888	5297	20715	11970	9498	49368	59206
JULY 18/19	953	557	1206	436	1838	2768	7758	1955	2282	13719	10517	19234	47707	50872
JULY 19/20	995	1226	4623	20984	3217	8857	39902	1977	2174	10699	9273	8204	32327	40085
JULY 20/21	476	5726	20684	32509	17781	11800	88976	6470	16730	9087	4265	1137	37689	77591
JULY 21/22	381	4569	114737	19567	22446	26462	188162	10336	35637	18608	3712	568	68861	157837
JULY 22/23	262	11882	35492	31327	15197	14395	108555	47577	65415	27464	17855	5871	164182	352344
JULY 23/24	238	9263	44757	50854	29421	54209	188742	23595	41377	43406	20995	9679	139052	247607
JULY 24/25	2478	19336	53653	31612	55715	71578	234372	38965	52888	44935	10566	5160	152514	341256
JULY 25/26	1203	5628	16352	14254	21834	16524	75795	21302	34909	37293	11190	4665	109359	343731
JULY 26/27	1418	3902	5987	19184	3189	17075	50755	22875	38010	23296	10895	2200	97336	173131
								11527	34063	29183	14166	9597	98536	149291

* Soundings incomplete

NB. #'S MAY DIFFER SLIGHTLY FROM FIELD SHEET TOTALS DUE TO ROUNDING ERRORS

TABLE 2 . RIVERS INLET 1987 DAILY SALMON CATCH

DATE	OPR	SOCK	COHO	PINK	CHUM	CHIN	JACK	STHD
JUNE 28/29	148	1,899	316	25	176	280	160	45
JUNE 30	100	816	206	90	66	182	128	27
TFW	248	2,715	522	115	242	462	288	72
TTD	248	2,715	522	115	242	462	288	72
JULY 5/6	326	19,146	264	319	238	156	36	31
JULY 7	328	16,965	327	737	1,120	285	232	122
TFW	654	36,111	591	1,056	1,358	441	268	153
TTD	902	38,826	1,113	1,171	1,600	903	556	225
July 12/13	500	42,294	146	3,121	1,610	104	40	19
July 14	400	35,869	401	3,345	810	264	28	45
TFW	900	78,163	547	6,466	2,420	368	68	64
TTD	1,802	116,989	1,660	7,637	4,020	1,271	624	289
July 19/20	590	114,749	339	13,398	3,292	162	16	55
TFW	590	114,749	339	13,398	3,292	162	16	55
TTD	2,392	231,738	1,999	21,035	7,312	1,433	640	344
July 26/27	633	85,977	145	15,609	4,731	18	7	7
July 28	377	40,539	176	10,381	3,196	37	5	5
July 29	389	23,340	511	18,736	2,757	216	14	20
TFW	1,399	149,856	832	44,726	10,684	271	26	32
TTD	3,791	381,594	2,831	65,761	17,996	1,704	666	376
Aug 2/3	178	16,218	64	11,258	2,914	2	0	6
Aug 4	137	8,104	419	8,312	1,403	68	25	15
TFW	315	24,322	483	19,570	4,317	70	25	21
TTD	4,106	405,916	3,314	85,331	22,313	1,774	691	397
Aug 9/10	47	2,479	169	5,402	1,389	31	2	0
Aug 11	41	2,393	100	7,016	1,477	13	5	6
TFW	88	4,872	269	12,418	2,866	44	7	6
TTD	4,194	410,788	3,583	97,749	25,179	1,818	698	403
Aug 16/17	87	828	309	7,405	4,700	41	0	0
TFW	87	828	309	7,405	4,700	41	0	0
TTD	4,281	411,616	3,892	105,154	29,879	1,859	698	403

Target numbers observed in the sanctuary area were low until the end of the second week of the sounding program. At this time, estimated numbers of sockeye increased significantly. The sounding program, originally scheduled to end the night of July 24th was extended until the night of July 26th upon the request of the local fishery officer Brian Lunn. The reasons for this decision included a strong indication of fish still to enter the Area 9 net fishery and few reports of any large numbers of fish migrating up the Wannock River.

Peak counts were made on the evenings of July 21-24. Counts were beginning to decline during the last two nights of sounding. Fish were reported to have left the sanctuary area and ascended the Wannock on the high evening tide of July 16. Owikeno Village reported small numbers of fish moving upriver from July 20 onwards.

Pink migration into the inlet usually begins towards the end of July. Soundings are generally ended by this time as the mixed species composition confounds the estimation of sockeye.

Although technical problems were experienced with the tachometer on the Walker Rock these should have had no effect on the estimates of fish sounded in the area. The estimates are determined through a relationship of the number of targets observed to the number of metres covered between pings. The reason for attempting to follow a constant speed between echo sounding trials is to maintain a similar metre/ping ratio. Although sea factors such as tide direction, water conditions and wind speed will also affect total boat speed, a constant RPM is generally followed. A variance in the number of metres/ping between trials only prevents a comparison of the actual number of targets observed within a transect, not the final estimate of fish present.

SUMMARY OF FIELD NOTES:

JULY 7/8- Left dock at 9:00 pm. Arrived back at 1:30 pm.

- Walker Rock Crew: Skipper- Robert Alton, Biologist- Barbara Thomson, First Mate- Robert Tremblay. Ron Goruk on board for first 3 nights.
- trial night to test equipment and procedures.
- Walker Rock: problems with the TAC
- only the RD 102 Grid was sounded, no targets were recorded throughout the grid. Continued sounding from the end of Transect E to Dawson's Landing, approximately 2 targets were recorded within the 10 Fathom depth (about 20 targets were recorded at approximately 20 fathoms).
- the weather for the day was overcast and drizzle, during the sounding the sky was overcast.

Times of grid surveys- RD 102 Grid Pattern

A	10:25-10:36 pm	(11:25.44 min)
B	10:43-10:52 pm	(9:26.75 min)
C	10:57-11:13 pm	(15:11.98 min)
D	11:17-11:29 pm	(12:37.01 min)
E	11:36-11:46 pm	(9:29.50 min)

Echo sounder Gain=9
Walker Rock RPM=800 (approximate due to mechanical difficulties)

JULY 8/9- Left dock at 9:00 pm. Arrived back at 3:00 am.

- first full night of echo sounding.
- the TAC on the Walker Rock still irregular- so vessel speed may not be accurate.
- a total of 3 targets were seen throughout the entire series of transects. Sounded from the end of Transect E, RD 102 to Stone Point in a zigzag pattern.
- the weather was overcast with drizzle all day, at night the sky began to clear.

Times of surveys-

Miss Robyn Grid:			Course
6	11:11-11:19 pm	(7:25.76 min)	167 SE
5	11:20-11:28 pm	(7:50.25 min)	327 NW
4	11:33-11:42 pm	(8:26.69 min)	174 SE
3	11:46-11:56 pm	(9:40.14 min)	328 NW
2	12:02-12:20 am	(17:18.78 min)	175 SE
1	12:25-12:40 am	(15:21.05 min)	334 NW

RD 102 Grid:

A	12:45-12:56 am	(11:01.76 min)	175 SE
B	12:59-1:10 am	(11:30.65 min)	320 NW
C	1:15-1:33 am	(17:48.37 min)	152 SE
D	1:37-1:48 am	(10:59.49 min)	325 NW
E	1:51-2:00 am	(8:39.22 min)	168 SE

Echo sounder Gain=9
Walker Rock RPM=800 (approximate)

July 9/10- Left dock at 8:45 pm. Arrived back at 2:15 am.

- the weather had been clear sky all day, hot with a breeze; clear at night. The tides were low over the last couple of days. Extreme low and high tides expected in the next few days.
- due to the lack of fish (indicated by both the echo sounding and a lack of jumpers in the Inlet) it was decided to do only a partial sounding of the Miss Robyn Grid, a full sounding of the RD 102 Grid, and a partial sounding of Sub-area 9-5 (zigzag across Inlet) to Stone Point.
- the TAC on the Walker Rock still unrepaired, the rpm throughout the surveys are estimated.
- a few targets were seen below 10 fathoms, only 1 target seen above 10 fathoms.

Times of surveys-
Miss Robyn Grid:

6	10:44-10:50 pm	(6:14.17 min)	175 SE
5	10:51-10:58 pm	(7:22.96 min)	325 NW
4	11:03-11:10 pm	(7:57.71 min)	170 SE

Continued down inlet to Transect #1 @ 800 rpm

1	11:30-11:42 pm	(11:54.01 min)	320 NW

RD 102 Grid:

A	11:51-12:02 am	(11:04.95 min)	171 SE
B	12:04-12:14 am	(10:06.80 min)	320 NW
C	12:18-12:34 am	(14:56.93 min)	155 SE
D	12:38-12:48 am	(9:30.00 min)	325 NW
E	12:53-1:00 am	(8:03.70 min)	167 SE

Echo sounder Gain=9
Walker Rock RPM=800 (approximate)

July 10/11- Left dock at 8:55 pm. Arrived back at 2:25 am.

- weather for the day was clear with some haze, warm; evening high cloud.
- the morning tide was low (-.3 m), the peak high tide (midnight PST) 4.4 m. This is the first of three extreme tide patterns.
- TAC still irregular- part should be delivered by July 11.
- The sounding is currently being used to establish the presence of fish, not to get highly accurate estimations. Again, the transects were not run completely- a couple at the head of the inlet (Miss Robyn Grid), the complete RD 102 Grid, and a survey of Subarea 9-5 (from the end of Transect E, RD 102 to Stone Pt). In subarea 9-5 some targets were recorded at depths of approx. 20 fathoms, one target was seen withing the recording range.
- this morning the guardian saw jumpers at Shotbolt Bay, yesterday evening, Brian Lunn saw jumpers at Brown's Bay (though no targets were seen later in the evening).
- at 10:15 pm outside of Shotbolt Bay, the Simrad Skipper colour sounder indicated a small school of fish within 4 fathoms of the surface (possibly sockeye).

Times for surveys-

Miss Robyn Grid:			Course
6	10:59-11:07 pm	(7:26.74 min)	185 SW
5	11:07-11:14 pm	(6:50.25 min)	326 NW
	Run to Shotbolt Bay to transect #1, a few targets (and a few possible targets) seen during run (15 targets total).		
1	11:44-11:57 pm	(13:02.29 min)	335 NW

RD 102 Grid:			
A	12:05-12:15 pm	(10:11.21 min)	177 SE
B	12:19-12:29 pm	(9:22.61 min)	320 NW
C	12:35-12:50 pm	(15:05.06 min)	155 SE
D	12:54-1:03 am	(8:15.49 min)	330 NW
E	1:07-1:16 am	(8:30.14 min)	159 NW

Echo sounder Gain =9
Walker Rock RPM=800 (approximate)

July 11/12 - Depart 9:00 pm. Arrive back at 2:40 am.

- weather sunny and warm all day with a breeze, clear with some high cloud at night.
- reports of jumpers in passages outside of Dawson's (but not a lot).
- a few targets seen on Simrad colour screen on way up to inlet head.
- part for TAC not in yet, for tonight's survey RPM set at start and speed is unchanged until the end of all grid surveys (RPM estimated, TAC seems to work at times and then registers zero).
- all grids surveyed tonight.
- highest tide of pattern due tonight at 00:47 am PST (4.4 m), the lowest tide of pattern due at 7:43 am PST (-.5 m).
- from the end of Transect E, RD 102 to past Stone Point, subarea 9-5 was sounded down the middle of the inlet at 800 RPM. The number of targets seen in this area were 12 @ 10 fathoms or less, 22 @ greater than 10 fathoms, and 1 @ the surface. The total run time of this section was 44 minutes.

Times of Surveys-

Miss Robyn Grid:			Course
6	10:52-10:59 pm	(6:57.75 min)	181 SW
5	11:00-11:07 pm	(6:58.63 min)	326 NW
4	11:12-11:20 pm	(7:45.09 min)	172 SE
3	11:25-11:34 pm	(9:28.44 min)	325 NW
2	11:38-11:50 pm	(12:14.15 min)	185 SW
1	11:59-12:13 am	(14:25.09 min)	330 NW

RD 102 Grid:			
A	12:21-12:31 pm	(10:18.03 min)	175 SE
B	12:36-12:46 pm	(9:18.49 min)	315 NW
C	12:51-1:04 am	(13:35.43 min)	153 SE
D	1:09-1:19 am	(9:31.85 min)	326 NW
E	1:24-1:32 am	(8:40.49 min)	160 SE

Echo sounder Gain = 9
RPM = 800 (approximate)

July 12/13- Depart at 8:40 pm. Arrive back at 3:30 am.

- fishery started at 6:00 pm, fishing up to 9-4 (Stone Point)
- weather hot with wind, sky clear all day
- TAC part put in, TAC still somewhat irregular though
- high tide 4.4 m at 00:47 am PST
- a few targets at >10 F in both grids
- in general, there were few targets between transects
- from RD 102, Transect E to Stone Point (9-5), some echoes apparent on Simrad colour sounder

Times of Surveys-

Miss Robyn Grid:			Course
6	10:56-11:03 pm	(7:32.71 min)	170 SE
5	11:04-11:12 pm	(7:52.18 min)	325 NW
4	11:19-11:29 pm	(9:25.71 min)	173 SE
3	11:34-11:45 pm	(10:38.51 min)	325 NW
2	11:53-12:12 am	(18:51.14 min)	180 SW
1	12:18-12:36 am	(17:18.39 min)	330 NW
RD 102 Grid:			
A	12:49-1:01 am	(12:27.99 min)	170 SE
B	1:07-1:19 am	(11:34.34 min)	319 NW
C	1:28-1:45 am	(18:04.73 min)	154 SE
D	1:51-2:02 am	(10:40.90 min)	332 NW
E	2:08-2:17 am	(9:29.16 min)	163 SE

Echo sounder Gain=9
RPM=800

July 13/14- Depart at 8:45 pm. Arrive back at 4:10 am.

- weather clear, sunny and windy; early evening cloudy, clearing by end of sounding.
- TAC still irregular. Conducted sounding at slightly slower speed than before (in case past soundings were run too fast). Heavy seas also slowed the vessel. (TAC repaired July 14).
- school of fish seen at Brown's Bay, schools near Kilbella Bay on way to head of inlet (Simrad Colour monitor).
- more targets evident between grids than in past (especially in RD 102), not as many targets at deeper depths. Overall fish presence greater than before.

Times of Surveys-
Miss Robyn Grid:

6	10:55-11:05 pm	(9:54.89 min)	180 S
5	11:06-11:16 pm	(10:48.11 min)	325 NW
4	11:24-11:35 pm	(11:01.63 min)	172 SE
3	11:42-11:55 pm	(13:38.86 min)	325 NW
2	12:07-12:30 am	(22:22.02 min)	176 SE
1	12:37-12:57 am	(19:12.89 min)	333 NW

RD 102 Grid:

A	1:12-1:24 am	(12:02.49 min)	169 SE
B	1:30-1:43 am	(12:25.37 min)	315 NW
C	1:51-2:10 am	(19:10.65 min)	152 SE
D	2:17-2:29 am	(10:51.09 min)	325 NW
E	2:34-2:45 am	(10:58.95 min)	160 SE

Echo sounder Gain=9
RPM=800 (approximate)

July 14/15- Depart at 9:00 pm. Arrive back at 3:30 am.

- weather sunny with strong winds, evening clear and intermittent cloud.
- fishery closed at 6:00 pm.
- targets seen above Kilbella Bay to head of inlet on Simrad Colour sounder.
- TAC still irregular, have attempted to maintain same speed as selected last night (seas calmer so times slightly faster).
- beach targets in evidence in both grid areas.
- fewer targets at depths than before.
- most of targets in lower reaches of Miss Robyn Grid and upper section of RD 102 Grid.

Times for Surveys-
Miss Robyn Grid:

			Course
6	11:00-11:06 pm	(6:48.77 min)	180 S
5	11:07-11:15 pm	(7:05.66 min)	332 NW
4	11:20-11:30 pm	(9:17.80 min)	173 SE
3	11:35-11:47 pm	(12:12.90 min)	325 NW
2	11:56-12:15 am	(19:20.30 min)	173 SE
1	12:22-12:41 am	(18:59.94 min)	335 NW

RD 102 Grid:

A	12:52-1:04 am	(12:50.59 min)	174 SE
B	1:08-1:20 am	(12:14.59 min)	318 NW
C	1:27-1:47 am	(19:35.81 min)	151 SE
D	1:54-2:07 am	(12:35.00 min)	332 NW
E	2:13-2:25 am	(11:13.39 min)	156 SE

Echo sounder Gain=9
RPM=800 (appoximate)

July 15/16- Depart 9:00 pm. Arrive back at 3:40 am.

- weather sunny with cold winds, intermittent cloud at night.
- TAC still irregular, attempt to follow same times as last two previous nights.
- a number of targets were seen at the head of the inlet near the log boom with the Simrad Colour Sounder.
- very few targets were seen between transects in the Miss Robyn Grid, targets were present between the transects in the RD 102 Grid.

Times of Surveys-
Miss Robyn Grid:

6	10:53-11:03 pm	(9:32.42 min)	165 SE
5	11:04-11:14 pm	(9:49.04 min)	326 SW
4	11:20-11:32 pm	(11:22.90 min)	171 SE
3	11:38-11:52 pm	(13:16.60 min)	332 SW
2	12:01-12:22 am	(21:00.00 min)	174 SE
1	12:28-12:47 am	(19:04.55 min)	335 SW

RD 102 Grid:

A	12:38-1:10 am	(12:27.95 min)	174 SE
B	1:15-1:28 am	(13:02.66 min)	318 SW
C	1:35-1:56 am	(20:52.92 min)	145 SE
D	2:04-2:18 am	(14:11.32 min)	330 SW
E	2:23-2:35 am	(11:39.73 min)	160 SE

Echo sounder Gain=9
RPM = 800 (approximate)

July 16/17 - Depart 8:45 pm. Arrive back at 3:30 am.

- weather hot and clear, windy; night clear, sea smooth.
- TAC problem not found yet- wiring of boat difficult to follow,engineers of other Fisheries boats have looked at it also.
- attempted to maintain a constant speed as set by previous nights (TAC often registers RPM for a couple of minutes and then quits- have assumed that when the TAC registers it is reading properly.
- scheduled openings for next week are 24hrs Sunday-Monday @6:00pm with the upper reaches of the Inlet closed.
- very little sign of fish schools on Simrad colour sounder on journey up to inlet head.
- call from individual upriver @10:35 pm, some fish had gone up the river on the rising tide (@6:00pm). At noon, Bob Alton and Bob Tremblay had seen jumpers at the inlet head at low tide.
- sounding started before low tide, high tide expected about 5:12 am.
- targets seen in 9-5 on return trip- fish had backed out of sanctuary area with the tide.

Times of Surveys-
Miss Robyn Grid:

6	10:55-11:05 pm	(9:40.73 min)	185 SW
5	11:06-11:16 pm	(10:26.97 min)	325 SW
4	11:23-11:34 pm	(11:06.31 min)	173 SE
3	11:40-11:53 pm	(12:59.55 min)	326 SW
2	12:03-12:21 am	(18:44.19 min)	170 SE
1	12:29-12:48 am	(19:40.62 min)	336 SW

RD 102 Grid:

A	1:00-1:13 am	(12:37.19 min)	174 SE
B	1:17-1:30 am	(12:57.48 min)	319 SW
C	1:37-1:57 am	(20:07.72 min)	150 SE
D	2:02-2:17 am	(14:19.62 min)	330 SW
E	2:23-2:34 am	(10:19.66 min)	160 SE

Echo sounder Gain=9
RPM = 800 (approximate)

July 17/18- Depart 8:50 pm. Arrive back at 3:40 am.

- weather sunny and hot all day, night clear, no wind.
- TAC part expected tomorrow.
- some targets seen around Brown's Bay on Simrad Colour Sounder on trip to head of inlet.
- reports of jumpers and sounded fish this morning (Don Taylor).
- from this night until end of survey, personnel change: Bob Tremblay recorded echo sounding times; Brian Lunn (FO) counted targets, computed fish counts.

Times of Surveys-
Miss Robyn Grid:

6	10:53-11:02 pm	(9:27.49 min)
5	11:04-11:14 pm	(10:10.38 min)
4	11:21-11:32 pm	(11:25.07 min)
3	11:38-11:53 pm	(14:41.94 min)
2	12:03-12:24 am	(20:24.34 min)
1	12:31-12:53 am	(21:20.28 min)

RD 102 Grid:

A	1:04-1:17 am	(13:14.32 min)
B	1:20-1:35 am	(14:25.22 min)
C	1:44-2:05 am	(21:14.83 min)
D	2:12-2:28 am	(15:38.19 min)
E	2:35-2:49 am	(12:26.28 min)

Echo sounder Gain=9
RPM = 800 (approximate)

July 18/19- Depart afternoon. Arrive back at 4:00 am.

- westerlies, extremely windy. Wind force 25 MPH, hard to keep on course. Rough seas.
- Miss Robyn Grid: few targets between transects, RD 102: targets between first few transects.

Times of Surveys-
Miss Robyn Grid:

6	10:54-11:04 pm	(9:54.34 min)
5	11:05-11:16 pm	(10:30.45 min)
4	11:25-11:37 pm	(11:15.04 min)
3	11:44-12:00 am	(15:35.09 min)
2	12:13-12:39 am	(25:43.58 min)
1	12:47-1:07 am	(20:04.85 min)

RD 102 Grid:

A	1:20-1:33 am	(13:23.69 min)
B	1:38-1:50 am	(11:42.52 min)
C	1:57-2:15 am	(17:39.19 min)
D	2:21-2:34 am	(13:37.21 min)
E	2:41-2:53 am	(12:01.33 min)

Echo sounder Gain=9
RPM = 800 (approximate)

July 19/20- Departure/Arrival times not recorded.

- sea rough, very windy.
- new gauge on TAC, transects run at 800 RPM.
- targets at head of inlet between transects, remaining run few targets between transects.

Times of Surveys-
Miss Robyn Grid:

6	11:00-11:09 pm	(9:56.33 min)
5	11:11-11:22 pm	(11:00.67 min)
4	11:31-11:44 pm	(12:46.10 min)
3	11:53-12:07 am	(15:35.74 min)
2	12:18-12:43 am	(24:73.46 min)
1	12:50-1:15 am	(25:17.93 min)

RD 102 Grid:

A	1:28-1:40 am	(12:14.22 min)
B	1:44-2:00 am	(15:21.30 min)
C	2:06-2:30 am	(23:44.46 min)
D	2:38-2:53 am	(15:04.79 min)
E	2:57-3:08 am	(10:12.39 min)

Echo sounder Gain=9
RPM = 800

July 20/21- Departure/Arrival times not recorded.

- targets between transects at head of inlet

Times of Surveys-
Miss Robyn Grid:

6	10:59-11:09 pm	(9:34.55 min)
5	11:10-11:20 pm	(9:56.29 min)
4	11:27-11:38 pm	(11:20.60 min)
3	11:45-11:58 pm	(13:32.28 min)
2	12:07-12:28 am	(20:58.35 min)
1	12:34-12:55 am	(21:23.91 min)

RD 102 Grid:

A	1:05-1:18 am	(13:29.16 min)
B	1:22-1:35 am	(13:21.53 min)
C	1:42-2:04 am	(22:21.39 min)
D	2:10-2:21 am	(11:20.43 min)
E	2:32-2:43 am	(11:16.59 min)

Echo sounder Gain=9
RPM = 800

July 21/22- Departure/Arrival times not recorded.

- sea rough and choppy.
- targets throughout both grid areas, numerous targets between RD 102 transects.

Times of Surveys-
Miss Robyn Grid:

6	10:56-11:06 pm	(10:26.22 min)
5	11:09-11:19 pm	(10:54.25 min)
4	11:29-11:41 pm	(11:59.79 min)
3	11:50-12:04 am	(14:57.25 min)
2	12:15-12:38 am	(22:56.93 min)
1	12:44-1:08 am	(23:42.18 min)

RD 102 Grid:

A	1:20-1:34 am	(13:16.24 min)
B	1:37-1:52 am	(14:31.52 min)
C	1:58-2:20 am	(21:33.53 min)
D	2:26-2:43 am	(17:02.44 min)
E	2:49-3:00 am	(11:11.46 min)

Echo sounder Gain=9
RPM = 800

July 22/23- Departure/Arrival- no times recorded

- Miss Robyn Grid: numerous targets between transects at inlet head.
- RD 102 Grid: targets between first few transects. Overall, targets concentrated near inlet head and in innermost RD 102 transects.
- targets present through 9-5 on return leg.

Times of Survey-
Miss Robyn Grid:

6	10:58-11:08 pm	(10:28.00 min)
5	11:10-11:20 pm	(10:33.01 min)
4	11:29-11:40 pm	(11:23.79 min)
3	11:48-12:02 am	(14:21.54 min)
2	12:13-12:35 am	(22:19.59 min)
1	12:42-1:06 am	(24:18.33 min)

RD 102 Grid:

A	1:20-1:32 am	(12:50.59 min)
B	1:37-1:52 am	(14:37.84 min)
C	1:58-2:20 am	(22:01.08 min)
D	2:27-2:43 am	(16:42.69 min)
E	2:47-2:59 am	(10:45.41 min)

Echo sounder Gain=9
RPM = 800

July 23/24 - Departure/Arrival times not recorded.

- Miss Robyn Grid: targets at head of inlet between transects, targets between transects in RD 102 grid, targets at depths greater than 10 Fathoms throughout RD 102.

Times of Survey-
Miss Robyn Grid:

6	11:00-11:12 pm	(12:01.86 min)
5	11:14-11:25 pm	(11:08.55 min)
4	11:35-11:46 pm	(12:45.94 min)
3	11:56-12:11 am	(15:33.58 min)
2	12:22-12:45 am	(24:19.80 min)
1	12:53-1:18 am	(25:09.03 min)

RD 102 Grid:

A	1:31-1:47 am	(15:14.37 min)
B	1:52-2:06 am	(14:19.97 min)
C	2:13-2:37 am	(23:50.35 min)
D	2:45-3:01 am	(16:23.95 min)
E	3:06-3:17 am	(11:13.22 min)

Echo sounder Gain=9
RPM = 800

July 24/25- Departure/Arrival times not recorded.

- Miss Robyn Grid: targets between transects at head of inlet,targets between transects at top end of RD 102, some towards end.

Times of Surveys-
Miss Robyn Grid:

6	10:57-11:08 pm	(11:45.46 min)
5	11:10-11:20 pm	(10:46.68 min)
4	11:29-11:42 pm	(12:34.27 min)
3	11:51-12:06 am	(15:03.65 min)
2	12:17-12:42 am	(24:49.79 min)
1	12:52-1:14 am	(22:46.90 min)

RD 102 Grid:

A	1:27-1:41 am	(13:56.49 min)
B	1:46-2:02 am	(14:57.13 min)
C	2:08-2:33 am	(22:24.54 min)
D	2:40-2:51 am	(14:20.78 min)
E	3:00-3:11 am	(11:29.40 min)

Echo sounder Gain=9
RPM = 800

July 25/26- Departure/Arrival times not recorded.

- Miss Robyn Grid: targets between transects at head of inlet. RD 102: numerous targets between transects at top end, some showing throughout. Targets present below 10 F.

Times of Surveys-
Miss Robyn Grid:

6	10:59-11:08 pm	(9:12.85 min)
5	11:10-11:19 pm	(9:42.40 min)
4	11:28-11:40 pm	(11:11.91 min)
3	11:47-12:01 am	(14:13.86 min)
2	12:12-12:33 am	(21:42.29 min)
1	12:42-1:02 am	(20:06.88 min)

RD 102 Grid:

A	1:17-1:30 am	(12:33.59 min)
B	1:37-1:50 am	(12:44.66 min)
C	1:58-2:18 am	(20:42.67 min)
D	2:26-2:39 am	(12:32.82 min)
E	2:45-2:58 am	(12:19.37 min)

Echo sounder Gain=9
RPM = 800

July 26/27- Departure/Arrival times not reported.

- Miss Robyn Grid: some targets between transects, RD 102: targets between transects at top end. Targets below 10 F. Targets in 9-5 and 9-4 on return run.
- last night of survey.

Times of Surveys-

Miss Robyn Grid:

6	10:53-11:03 pm	(9:54.85 min)
5	11:05-11:14 pm	(9:45.85 min)
4	11:21-11:33 pm	(10:57.37 min)
3	11:40-11:53 pm	(13:24.57 min)
2	12:04-12:24 am	(20:15.78 min)
1	12:30-12:49 am	(19:14.96 min)

RD 102 Grid:

A	1:04-1:16 am	(11:58.01 min)
B	1:22-1:35 am	(12:27.91 min)
C	1:43-2:05 am	(21:44.58 min)
D	2:11-2:24 am	(12:47.26 min)
E	2:30-2:41 am	(10:47.88 min)

Echo sounder Gain=9
RPM = 800

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APPENDIX I. Tide Levels (m) during 1987 Sounding Trials (PST)
(Tides at Wadhams, Rivers Inlet)

DATE	TIME (HOURS)	TIDE HEIGHT (METRES)	TIME (HOURS)	TIDE HEIGHT (METRES)	TIME (HOURS)	TIDE HEIGHT (METRES)
JULY 7/8	21:12	4.3	04:28	0.6		
JULY 8/9	22:07	4.5	05:18	0.3		
JULY 9/10	22:57	4.7	06:08	0.0		
JULY 10/11	17:53	1.8	23:52	4.9	06:58	-0.2
JULY 11/12	18:43	1.7	00:47	4.9	07:43	-0.2
JULY 12/13	19:43	1.5	01:37	4.9	08:28	-0.1
JULY 13/14	20:33	1.5	02:27	4.6	09:13	0.2
JULY 14/15	21:28	1.5	03:28	4.3		
JULY 15/16	22:28	1.5	04:12	4.0		
JULY 16/17	17:02	4.2	23:33	1.5	05:12	3.6
JULY 17/18	17:52	4.1	00:43	1.5	06:27	3.2
JULY 18/19	18:47	4.1	01:53	1.4	07:52	3.1
JULY 19/20	19:47	4.0	03:13	1.3		
JULY 20/21	20:47	4.0	04:03	1.1		
JULY 21/22	21:42	4.0	04:58	0.9		
JULY 22/23	22:27	4.1	05:43	0.8		
JULY 23/24	17:28	2.1	23:12	4.2	06:18	0.6
JULY 24/25	18:03	2.0	23:52	4.2	06:53	0.5
JULY 25/26	18:43	1.9	00:32	4.3	07:23	0.5
JULY 26/27	19:18	1.8	01:07	4.3	07:53	0.5